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(54) Ground surface material

(57) A substitute ground surface material comprises coal ash or aluminium smelter crushed to the desired particle size. This material may be mixed with a binder such as shaped sand or silica. The surface material may have an overlay comprising rubber or plastic granules and the surface may include a moisture retaining additive. The materials can be chosen so that the surface will provide the desired properties.

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IMPROVED ALL SEASON SURFACE

The present invention relates to improved all season surfaces, in particular a multi-component all season surface which is characterised by desirable properties of surface drainage, impact resistance and durability, to the preparation thereof and the use as a high performance race or running track surface, entertainment or other performing arena surface or training surface for animals or the like, in particular an equestrian surface.

Indoor and outdoor surfaces which are dedicated to high performance animal or human use, for example equestrian surfaces or the like such as lunging rings, polo pitches, dressage and show jumping rings, circus and rodeo arenas, racing tracks for example for horses, greyhounds or even humans, artificial cycling tracks such as motocross, BMX and all terrain cycle tracks and the like must be capable of providing the intended and desired performance properties in all manner of seasonal variations, both in terms of humidity, temperature, variations in atmospheric pressure and the like. Compromising these properties can at best lead to reduced performance in terms of racing, training or entertaining, and at worst can lead to injury or damage as a result of excessive shock impact caused by too hard a surface, excessive strain and additionally damage or shock impact which may be caused by too soft and penetrable a surface and in particular penetration through to the foundation thereof, and with the additional result that the soft surface composition is thrown or churned up causing surface unevenness and retention of surface components in or on the performers hooves, feet, wheels or equivalent.

Attempts to overcome these problems have been made in the field of equestrian surfaces which demand top performances of sensitive and fragile animals. A common type of surface employed is sand based, in particular but less commonly comprises a treated or coated sand, for example resin, wax or grease, such as Vaseline coated sand. This surface provides to some extent the desired properties of drainage, impact resistance and density but is extremely expensive and thus not available for all purposes. In view of the extensive training and performing of horses around the world this situation is obviously not adequate and is placing animals at unnecessary risks.

Moreover this coated sand surface is not readily adaptable for the individual requirements of different surfaces, it being apparent that the nature of training, racing or performing will demand degrees of density, impact resistance and the like to cater for the intended impact, and moreover the indoor and outdoor or geographical location will demand different levels of prevailing surface drainage.

Accordingly there is a need for an improved all season surface for the above defined applications, which surface is available at realistic expense and is adaptable to provide the necessary property variations for the intended purpose.

It has now surprisingly been found that a multi-component all season surface is capable of meeting these needs in excellent manner.

In its broadest aspect the invention relates to a multi-component all season surface which is comprised in a structure adapted to give a desired degree of surface drainage, impact resistance or density, and durability for any intended

intensity or weight of impact transmitted directly or otherwise.

In a first aspect the present invention relates to a multi-component all season surface comprising an intimate mixture of particles of a porous material having a desired particle size distribution and being substantially resistant to dissolution, fracture or other destructive influence. Preferably the material, hereinafter Component 1, comprises an intimate mixture of particles of porous mineral oxides. It will be appreciated that the composition of component 1 may be selected according to its ability to perform the desired function, whereby the particular mineral oxides present may vary in nature and quantity and will be selected according to their contribution in terms of porosity, water retention, ability to bind, fracture and impact resistance, environmental acceptability, low dust forming properties, fire resistance, reactivity and the like. Accordingly Component 1 may be prepared as desired according to a suitable recipe combining any one or more of oxides of the third, fourth, fifth and/or sixth Periods of the Periodical Table of the Elements, specifically selected from Groups 1, 2, 11, 12 and 13 and from the Transitional Elements, preferably selected from the elements sodium, potassium, magnesium, calcium, strontium, barium, titanium, zirconium, chromium, manganese, iron, cobalt, zinc, aluminium, silicon and/or phosphorus.

It is particularly advantageous and convenient that such a source of mineral oxides is readily available in the form of a fuel ash derived in fairly specific manner, whereby preferably Component 1 comprises a crushed coal ash or aluminium smelter which has been burnt at high temperature, ie is a fast burn ash, preferably in excess of 500°C, for example in the range of 800°C to 1200°C at atmospheric pressure, more preferably in the range of 900°C to 1100°C for example 1000°C at atmospheric pressure, or at a corresponding

reduced temperature obtained at elevated pressure combustion. Suitably the temperature required is selected so as to render the ash with the suitable porosity desired and rid the ash of impurities which would otherwise cause the ash to form a slurry in solution during a subsequent washing stage or in use.

It will be apparent that other sources of Component 1 may be available and may be identified by techniques known to the man skilled in the art. It is notable that too low a combustion temperature fails to rid the ash of slurry forming impurities, and would therefore otherwise require additional treatment stages for the isolation of such impurities. Moreover certain fuel types will not deliver the necessary minerals which may provide the desired porosity and other properties whereby the use of for example a wood burn ash or the like would require the supplementation with certain minerals to extend or enhance the properties thereof.

Optionally and preferably the surface comprises as a second component, hereinafter Component 2, a suitable binder adapted to provide the desired resilience and durability. Any form of binder known in the art may be employed which is capable of performing the desired function and complementing the properties of the first component. Preferably the binder comprises a fracture resistant geometric shaped particulate material, such as shaped sand or silica or an equivalent thereof.

The binder may be present as an intimate mixture with Component 1 by means of being mixed prior to or during the construction of the surface, or by a combination of these means.

Optionally the surface comprises an additional overlayer of resilient material where desired, for example comprised of rubber or plastic granules or the like, hereinafter Component 3.

Optionally the surface comprises an additional component present as an intimate mixture with the surface components or as an additional overlayer, comprising a moisture retaining additive, hereinafter Component 4. Suitably such additive is adapted to retain moisture for prolonged periods of the order of weeks or months and serves to compensate for excessive periods of dry weather. It is a particular advantage that such additive allows the necessary water retention without the need to reduce the porosity of the surface material itself.

The drainage requirement of the surface of the invention has hereinbefore been described, in particular the requirements of the component materials to provide this function. Suitably this surface comprises an additional draining underlayer or is located on a suitable draining foundation. Accordingly such underlayer or foundation is adapted to support the surface and ensure the desired run off of moisture or atmospheric precipitation or indeed deliberate watering which may be applied periodically to the surface. Suitably such underlayer or foundation comprises any porous compacted or integral surface, preferably comprises compacted stone, flint, brick chip, broken rubble or the like or a smooth or rough surfaced integral foundation layer having drainage means spaced at suitable intervals. Most preferably the underlayer or foundation comprises compacted stone.

Components 1 to 4 as hereinbefore defined and indeed any granular underlayer or foundation component suitably comprise different particle

grades which may conveniently be obtained by any known means in the art, for example by means of controlled crushing or alternatively by compositing a powdered material in suitable manner. It will be appreciated that the particle grade range required is determined by the intended application. In a particular application therefore, a surface of the invention intended for use as an equestrian surface may conveniently comprise a particle grade whereby less than or equal to substantially 10% of the material is capable of passing through a sieve having apertures of the order of 100 microns, preferably of the order of 95 microns and more than 75% of the material is capable of passing through a sieve comprising apertures of the order of 1500 microns, preferably of the order of 2000 microns as determined according to British Standard 1976, Part 1, 1989. More preferably such particle grade distribution is such that at least approximately 35% of the material passes through sieve apertures in the range of the order of 75 to 212 microns, optionally whereby a remaining at least approximately 35% of material passes through sieves apertures in the range of the order of 212 to 2000 microns, or in total at least approximately 70% or the material passes through sieve apertures in the range of the order of 75 to 212 microns. Percentages are given as weight percent. It will be appreciated that a variation in particle grade enhances the disorder of the surface whereby drainage and binding are enhanced.

Suitably Components 1 and 2 are washed in appropriate manner prior to forming within the surface. Preferably Component 1 is waterwashed to remove any remaining impurities which may be present and will otherwise cause slurrying of the component and prevent isolation and drying thereof. Preferably washing is performed at least twice depending on the source of Component 1 and the need for impurity removal. In particular it is desired to remove lead and similar impurities. More preferably washing is performed

in brine water or the equivalent which enhances impurity removal and also depresses the freezing point of the component extending its useful seasonal range for optimum performance, even to temperatures of -5°C at atmospheric pressure.

Preferably Component 2 comprises angular silica which is acid washed. It will be apparent that the geometric property of such silica or sand contributes to its binding properties.

It will be apparent that not only the nature of Components 1 and 2 is variable whereby specific applications may be optimally addressed, but that the relative proportions and total proportions thereof are variable and can positively influence the performance of the surface.

According it will be apparent that Components 1 and 2 may be employed in any suitable manner, but preferably Components 1 and 2 are comprised in a combination of substantially separate and blended forms. For example Component 1 may be comprised in a first layer and compacted in suitable fashion, whereafter a blend of Components 1 and 2 which may be pre-blended or blended in situ i.e. on the ground, may be laid and compacted in suitable manner. The variation of layers and nature thereof will provide the desired resilience, coherence or binding and degree of acceptable shock impact.

Most preferably a first layer of Component 1 is laid to a depth of up to 500mm, more preferably of up to 200mm for example of the order of 175mm which may be compacted as appropriate to a depth of the order of 150 to 300mm for example.

Preferably a layer of Components 1 or 2 combined is laid to a depth of up to 500mm, for example of the order or 10 to 300mm, preferably 10 to 100mm which may be compacted in suitable manner.

Preferably a layer of acid silica washed sand is present to a depth of the order of up to 20mm. Such layer is suitably harrowed to mix with the adjacent underlayer of composite or of Components 1 and 2 as appropriate.

It will be appreciated that the manner and degree of compaction is also determining of the final performance properties of the surface. Accordingly a suitable compaction rate should be achieved by means of a suitable compaction device. Preferably a compaction rate of several metric tonnes per square inch is appropriate, for example of up to twelve tonnes per square inch, suitably of the order of ten tonnes per square inch. Suitably compaction is performed with a vibrating roller or with any suitable form of roller or mechanical or pneumatic stamp. It is essential that compaction is performed to such a degree that the substance to be compacted is able to interlock but without becoming too dense. Accordingly it will be apparent that appropriate rates may vary with materials used.

There is accordingly provided in a further aspect of the invention a method for the preparation of an all season surface as hereinbefore defined which comprises in a first stage the selection or preparation of a draining foundation or underlayer, in a second stage the laying of a multi component surface as hereinbefore defined with intermediate compaction and blending as desired, including laying the Component 1 material as hereinbefore defined, simultaneously or thereafter laying the Component 2 material as hereinbefore defined, and optionally simultaneously or thereafter laying the Component 3

and/or 4 material as hereinbefore defined.

Preferably the foundation or underlayer surface is primed for example with a layer of an intermediate hard angular material, for example such as limestone. Moreover it may be desired to provide a graded fall across such underlayer or foundation to assist drainage.

It will be apparent that the invention in its aspects as hereinbefore defined is capable of wide variation in terms of the materials and the preparation thereof wherein it may be reproduced in a multitude of discrete fashions achieving the desired purpose.

In a further aspect of the invention there is provided a method for the preparation of any of Components 1 to 3 as hereinbefore defined for the purpose of preparing a multi component all season surface as hereinbefore defined.

In a further aspect of the invention there is provided a component as hereinbefore defined for use in a multi component all season surface as hereinbefore defined.

In a further aspect of the invention there is provided the use of a multi component all season surface as hereinbefore defined for any of the above stated applications.

The invention will now be described with reference to the following non limiting examples which are intended as illustration thereof.

Example 1 - Preparation of Component 1.

A sample of coal ash or aluminium smelter is obtained by means of combustion, at elevated temperature in the region of 1000°C, of a suitable coal material. The ash obtained is twice washed in salt water to remove any impurities, including lead, filtered and dried. The ash is previously or thereafter crushed with a controlled weight and rate of crushing, is screened and filtered. The resulting Component 1 is obtained having composition as analysed and presented in Table 1 hereinbelow, and having particle grade as analysed and presented in Table 2 hereinbelow.

Table 1 - **XRF ANALYSIS OF COMPOSITION OF EXAMPLE 1**

Sample dried at 110°C		wt%
Silica	(SiO_2)	54.6
Titania	(TiO_2)	0.74
Alumina	(Al_2O_3)	19.7
Ferric Oxide	(Fe_2O_3)	13.2
Lime	(CaO)	5.56
Magnesia	(MgO)	2.75
Potash	(K_2O)	1.37
Soda	(Na_2O)	0.16
Phosphorus Pentoxide	(P_2O_5)	0.12
Chromium Sesquioxide	(Cr_2O_3)	0.02
Manganic Oxide	(Mn_3O_4)	0.20
Zirconia	(ZrO_2)	0.04
Zinc Oxide	(ZnO)	0.02
Barium Oxide	(BaO)	0.16
Strontia	(SrO)	0.03
Loss on ignition at 1025°C		1.28
Total		99.95

SO3 in the bead after fusion ~ 0.1%

This is not a total SO_3 figure but that remaining after L.O.I. and fusion.

Table 2 - **DETERMINATION OF DRY SIEVE ANALYSIS OF COMPOSITION OF EXAMPLE 1**

Sieve size (μm)	Cumulative % passing
2000	77.0
1000	60.6
500	48.9
300	41.5
212	35.1
150	20.3
106	8.5
75	2.0

The test was carried out as described in British Standard 1796: Part 1: 1989 using British Standard sieves indicated above and a Rotap sieve shaker.

Example 2 - Preparation of a Show Jumping Arena All Season Surface

The surface is prepared on a suitable foundation or layer in the following manner.

1. The surface needs to be laid on top of a porous stone base or "pad". Ideally this should consist of a 100mm depth of hard angular Limestone 40mm down to 5mm. There is also a requirement to have a 1 degree fall across this stone pad to assist drainage. The stone will need rolling twice over at a compaction rate of two tons per square inch.

2. The ash composite is laid on top of the stone pad to a depth of 175mm this will compact to 150mm when rolled. The ash will require rolling twice over with a vibro roller at ten tonnes per square inch.

3. 60mm of silica washed sand is then evenly spread on top of the compacted composite. A light chain harrow with spikes no longer than 65mm is passed over the sand to mix the sand and ash together.

Example 3 - Preparation of a Polo Field All Season Surface According to the Invention

This surface is prepared substantially as described in Example 2, but with the use of a layer of depth 13mm of silica washed sand in the third stage which is raked with a light chain harrow with spikes no longer than 15mm.

Example 4 - Preparation of Component 1

A sample of Burythorpe washed and dried 80 grade sand/ash (high temperature or fast burn coal ash) was obtained. The sample was treated according to the process of Example 1, and analysed with the properties as given in Tables 3 and 4 below. The component was found to provide excellent surfaces when laid according to Examples 2 and 3.

It was apparent that the component differed from that of Example 1 in its content of certain mineral oxides, specifically alumina, ferric oxide, lime, magnesia and potash and additionally omitted totally any content of soda, phosphorus pentoxide, manganic oxide, zinc oxide and barium oxide. The product was also of different particle grade and in particular of a much lower

particle grade range, illustrating thereby the flexibility of the present invention in means to provide the desired properties.

Table 3 - **TYPICAL CHEMICAL ANALYSIS OF EXAMPLE 4**

Silica	(SiO_2)	97.60
Iron	(Fe_2O_3)	0.16
Potash	(K_2O)	0.63
Titania	(TiO_2)	0.16
Lime	(CaO)	0.02
Alumina	(Al_2O_3)	1.20
Magnesia	(MgO)	0.02
Chrome	(Cr_2O_3)	0.01
Zirconia	(ZrO_2)	0.05
Strontia	(SrO)	0.01
Total		99.86
L.O.1.		0.22

Table 4 - **TYPICAL SIEVE ANALYSIS OF EXAMPLE 4**

Sieve Size(μm)	B.S.S.	% RETAINED
710	22	-
500	30	-
355	44	0.12
250	60	1.91
180	85	23.49
125	120	64.47
90	170	8.99
63	240	0.87
PAN	PAN	0.02
TOTAL	TOTAL	99.87
AFS	AFS	82

It is found that by the present invention, as exemplified by Examples 1 to 4, the aforementioned desired properties are provided in admirable manner. Specifically by use of the process of the invention as exemplified by Examples 2 and 3 the materials of Example 1 or 4 are laid to enable optimum performance whereby compaction rate is lower than that which would provide an overly dense or impact resistance surface which may cause damage to horses hooves and legs and is greater than that which would provide a surface of insufficient density whereby horses hooves would penetrate to the foundation layer and strike the stone base.

These properties have been found to be absent or insufficient by use of compositions not according to the invention. In particular a composition

comprising a slow burning ash such as generated by steam furnaces for example, were not suitable, in the absence of specific treatment, to remove slurry-forming compounds, and possibly of supplementing by the necessary additional compounds to provide the desired properties, whereby it may be seen at best as a more or less useful base or starting material for the preparation of Component 1, however it will be appreciated that the multi component nature of this product is not narrowly critical.

CLAIMS

1. Multi-component all season surface for competition, training, entertainment or performing art which is comprised in a structure adapted to give surface drainage, impact resistance or density and durability for any intended intensity or weight of impact transmitted directly or otherwise.

2. Multi-component surface as claimed in Claim 1 which comprises as Component 1 an intimate mixture of particles of a porous material having a desired particle size distribution and being substantially resistant to dissolution, fracture or other destructive influence.

3. Multi-component surface as claimed in Claim 1 or Claim 2 which comprises as Component 1 an intimate mixture of particles of porous mineral oxides, preferably selected from one or more oxides of the 3rd, 4th, 5th and/or 6th periods of the Periodic Table of the Elements, more preferably from groups 1, 2, 11, 12 and 13 and from the transition elements.

4. Multi-component surface as claimed in Claim 2 or Claim 3 wherein the porous material comprises a fuel ash, preferably a fast burn crushed coal ash or aluminium smelter, more preferably burnt at a temperature in excess of 500°C, more preferably in the range of 800°C - 1200°C at atmospheric pressure.

5. Multi-component surface as claimed in any one of Claims 1-4 which comprises as Component 2 a suitable binder adapted to provide the desired resilience and durability, preferably comprising a fracture resistant geometric

shaped particulate material preferably shaped sand or silica or an equivalent thereof.

6. Multi-component surface according to Claim 5 wherein the Component 2 is present as an intimate mixture with component 1 by means of being mixed prior to and/or during the construction of the surface.

7. Multi-component surface as claimed in any one of Claims 1-6 which comprises an additional over-layer of resilient material as Component 3, preferably of rubber or plastic granules or the like.

8. Multi-component surface as claimed in any one of Claims 1-7 which comprises an additional moisture retaining additive as Component 4.

9. Multi-component surface as claimed in any of Claims 1-8 which comprises an additional draining underlayer or is located on a suitable draining foundation.

10. Multi-component surface as claimed in any one of Claims 1-9 having a pre-determined particle grade range.

11. Multi-component surface as claimed in any of Claims 1-10 wherein components are pre-washed for the purpose of impurity removal and/or freezing point depression, preferably are washed with water or a water based solution.

12. Multi-component surface as claimed in any of any one of Claims 1-11 wherein individual components are present in a combination of substantially

separate and blended forms, preferably in a plurality of layers which may be inter-blended or blended *in situ* and compacted.

13. Multi-component surface as claimed in any one of Claims 1-12 comprising individual components in a depth of up to 500 mm, compacted to a depth of the order of 150-300 mm.

14. Multi-component surface as claimed in any one of Claims 1-13 which is compacted at a rate of up to 12 metric tonnes per sq. inch.

15. A method for the preparation of multi-component surface as claimed in any one of Claims 1-14 which comprises in a plurality of stages:

selecting or preparing a plurality of components of a structure adapted to give surface drainage, impact resistance or density, and durability for any intended intensity or weight of impact transmitted directly or otherwise; and in a second stage the laying of a multi-component surface as hereinbefore defined with intermediate compaction and blending as desired.

16. A method according to Claim 15 comprising laying the Component 1 material as hereinbefore defined, simultaneously or thereafter laying the Component 2 material as hereinbefore defined, and optionally simultaneously or thereafter laying the Component 3 and/or 4 material as hereinbefore defined.

17. A method for the preparation of a component of a multi-component surface as hereinbefore defined with reference to any of Claims 1-14.

18. A component as hereinbefore defined with reference to any of claims 1-14 for use in a multi-component all season surface as hereinbefore defined.

19. The use of a multi-component all season surface as defined with reference to any one of Claims 1-18 for competition or training, entertainment or other performing art purpose.

20. A multi-component surface as hereinbefore defined with reference to the description and/or the Examples.

The Patent Office

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Application No:	GB 9711433.4	**Examiner:**	Alan Blunt
Claims searched:	1 to 20	**Date of search:**	9 September 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A6D (D39X)

Int Cl (Ed.6): E01C 13/00, 13/06

Other: On-Line Database: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2185490A	(EN-TOUT-CAS) - whole document	1 to 20
A	GB2184765A	(MANSFIELD SAND) - whole document	1 to 20
X	GB932032	(SIBERA) - whole document	1 to 20
X	GB722100	(SPURRIER) - whole document	1 to 20

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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&	Member of the same patent family		